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Quantifying sediment retention by restored wetlands using fallout radionuclide tracer technology (Cs-137 and Be-7): The River Odense, Denmark

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River restoration projects that allow temporary inundations of the floodplain are important for increasing the water storage potential of the landscape which can decrease flood risk to vulnerable downstream urban areas. During inundation, coarse and fine fluvial sediments are deposited on the floodplain leading to reduced organic matter and nutrient flux downstream. In this context, information on sediment accretion rates by floodplain units is required to inform restoration decisions. Sediment traps are widely used to determine contemporary accretion rates in floodplain units but there are questions about the representativeness and resolution of data. Here, we have tested the application of radionuclide tracer technology (Cs-137 and Be-7) for use in Danish river and floodplain monitoring for longer and shorter term quantification of sediment accretion rates.

Prior to the wet season, a network of AstroTurf mats was placed along three transects in the study zone of the Odense floodplain. Suspended sediment traps were installed in the channel and samples were collected during period of floodplain inundation to characterise the FRN activity concentrations in deposited material. Following a series of major inundation events, shallow (3 cm) sediment cores were collected to determine Be-7 inventory relative to a non-inundated reference site. Deeper cores (30 cm) were collected, including a section core, to quantify Cs-137 inventories on the floodplain relative to a reference site. All materials were analysed for particle size and a separation experiment was undertaken to characterise the relationship between particle size and FRN concentration. Cs-137 based accretion rates were in accord with long-term direct monitoring and provided a useful context for the contemporary extreme event data. Comparison of Be-7 based accretion estimates to Astro Turf mat deposition indicated that the Be-7 approach offers to provide high resolution retrospective accretion rate data for contemporary overbank events. The quality of the data, however, is highly sensitive to the particle size correction approach taken. The study illustrates the value of FRN-based techniques but also demonstrates the critical need for careful application of particle size correction procedures based on deposited material at each sampling point representative of the study period and a site-specific FRN-particle size relationship.